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President
T. MacCARTHY

TO: AIAM Environment & Energy Subcommittee

FROM: John M. Cabaniss, Jr.
Director, Environment & Energy

RE: **ENVIRONMENTAL & ENERGY STUDY INSTITUTE - Congressional Briefing on Air Pollution, Global Warming, and Petroleum Security - May 18, 2000**

On May 18, 2000, the Environmental & Energy Institute sponsored a Congressional briefing entitled *Air Pollution, Global Warming, and Petroleum Security: Is Vehicle Technology the Answer?* Attached is the notice for the meeting and copies of the presentations by John German of Honda and John DeCicco of American Council for an Energy-Efficient Economy.

JMC:dp

BUCKLE UP AMERICA
There's Just Too Much To Lose

CLI3631

ASSOCIATION OF INTERNATIONAL AUTOMOBILE MANUFACTURERS, INC.
1001 19TH ST. NORTH ■ SUITE 1200 ■ ARLINGTON, VA 22209 ■ TELEPHONE 703.525.7788 ■ FAX 703.525.8817
INTERNET: http://www.aiam.org

ENVIRONMENTAL AND ENERGY STUDY INSTITUTE

NOTICE

CAROL WERNER
EXECUTIVE DIRECTOR

122 C STREET, N.W., SUITE 700 ■ WASHINGTON, D.C., 20001 ■ 202-628-1400 ■ www.eesi.org

Air Pollution, Global Warming and Petroleum Security: Is Vehicle Technology the Answer?

Thursday, May 18, 2000, 3:30 - 5:00 p.m.
1539 Longworth House Office Building

EESI invites you to a Congressional briefing on the technology revolution taking place in the automobile industry. While Congress and the Administration continue to debate and promulgate new laws and regulations that affect automobiles, questions arise regarding how new technologies might transform the future of cars and trucks.

This briefing is being sponsored in conjunction with the Northeast Sustainable Energy Association (NESEA) American Tour de Sol, the national championship for electric vehicles. The Tour displays dozens of the latest "green" vehicles that will travel from New York City to Washington, showcasing some of the best electric and hybrid-electric vehicles in the world. This is the twelfth anniversary of the NESEA American Tour de Sol, a challenging real-world demonstration for automakers and students from the best universities and high schools around the country. The road rally ends Thursday, May 18 in Washington, DC on the Mall near the U.S. Capitol. Displays and ride-and-drives of the vehicles will be available.

Fundamental technology changes in the automobile are taking place right now that would have been inconceivable even five or tens years ago. Jack Smith, CEO of General Motors has stated "No car company will be able to thrive in the 21st century if it relies solely on the internal combustion engine." A Wall Street Journal article stated "Automakers…have reached a surprising consensus on an idea deemed heretical not long ago: A fundamental shift in engine technology is needed." Now billions of dollars are being invested in fuel cells, hybrids-electric drivetrains and advanced energy storage devices.

Several key federal policies will both impact and be impacted by this unknown future. Some of these major federal policies include the:

- **Clean Air Act:** Achieve federal standards for healthy air, establish state and regional implementation plans, and establish vehicle emissions standards.

(over)

- **Energy Policy Act:** Reduce oil imports by 10% by the year 2000, and 30% by 2010, require purchase of vehicles that are "substantially non-petroleum."
- **Corporate Average Fuel Economy (CAFE) Standards:** Establish miles per gallon corporate averages for passenger cars (27 mpg) and light trucks (20.7 mpg, includes sport utilities, pickup trucks and minivans) that are technically feasibility, economically practical and conserve energy.
- **Partnership for a New Generation of Vehicles:** Partnership with the federal government and domestic automakers to produce a production prototype vehicle that achieves up to three times the mpg or CAFE standard.
- **Climate Change Action Plan:** Stabilize greenhouse gas emissions to 1990 levels by 2000. **Kyoto Protocol:** Reduce greenhouse gas emissions 7 percent below 1990 levels by 2008-2012.
- **Transportation Equity Act for the 21st Century (TEA-21):** Fund highway, transit, safety, and environmental transportation programs.

What are the promising future vehicle technologies? How fast will they penetrate the market? What impacts do they have on air pollution, oil dependence and greenhouse gas emissions? What is the role of the federal government? These questions will be addressed at the briefing by experts from across the country. The briefing panelists will include:

- **John German, manager, Environmental and Energy Analysis, American Honda Motor Co., Inc.;**
- **John DeCicco, senior researcher, American Council for an Energy-Efficient Economy;**
- **Nancy Hazard, director, American Tour De Sol, Northeast Sustainable Energy Association (NESEA); and**
- **Christopher Borroni-Bird, Advanced Technology Research & Development Group, Daimler-Chrysler.**

The briefing is open to the public and reservations are not required. For more information, contact Beth Bleil at (202) 662-1886 or by email at bbleil@eesi.org. Please check out our website at www.eesi.org!

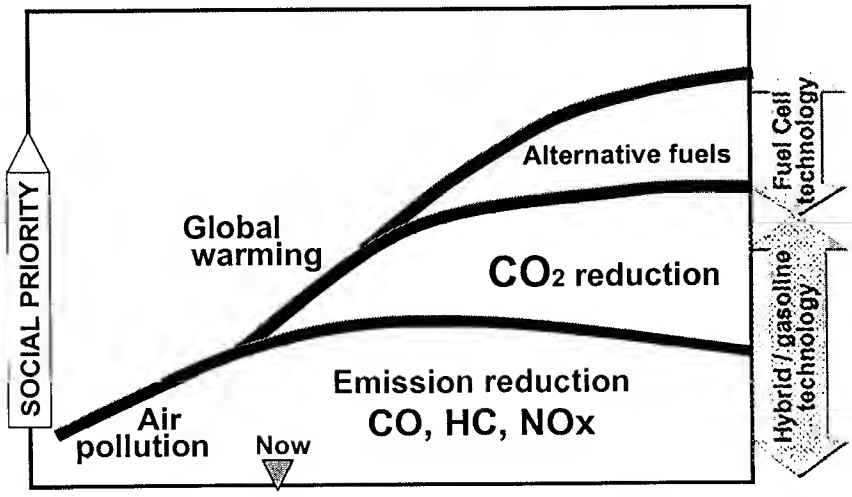
This briefing is part of EESI's series in support of Earth Day 2000!

Current and Future Vehicle Technology

John German
Manager, Environmental and Energy Analyses
American Honda Motor Co., Inc.

HONDA

Future Powerplant Issues



HONDA

Honda is the Industry Leader in Clean and Efficient Vehicles

- Highest CAFE of major OEMs
- Technically advanced F.E. leading models in the market
- Popular mass-market models with continual efficiency improvement

HONDA

Honda's Environmental Leading Products

PRODUCT	NOTES	EM	FE	CO_2	AFV
Civic LEV	1st Gasoline LEV	O			
Civic HX	Top FE with AT		O	O	
Honda	Top CAFE of Major OEMs		O	O	
LEV Expansion	Voluntary Expansion	O			
Accord ULEV	1st Gasoline ULEV	O			
EV PLUS	1st Advanced Battery	O		O	O
Civic GX (NGV) SULEV	Cleanest ICE in World	O		O	O
ZLEV Announcement	Cleanest Gasoline E/M	O			
Accord SULEV	1st Gasoline SULEV				
Insight	1st Hybrid in US		O	O	

HONDA

I ♥ CLEAN AIR

Sticking it on a Honda LEV would be redundant.

Of course, when it comes to a healthy environment, there's nothing wrong with a little repetition. Fortunately, we're not alone in this thinking.

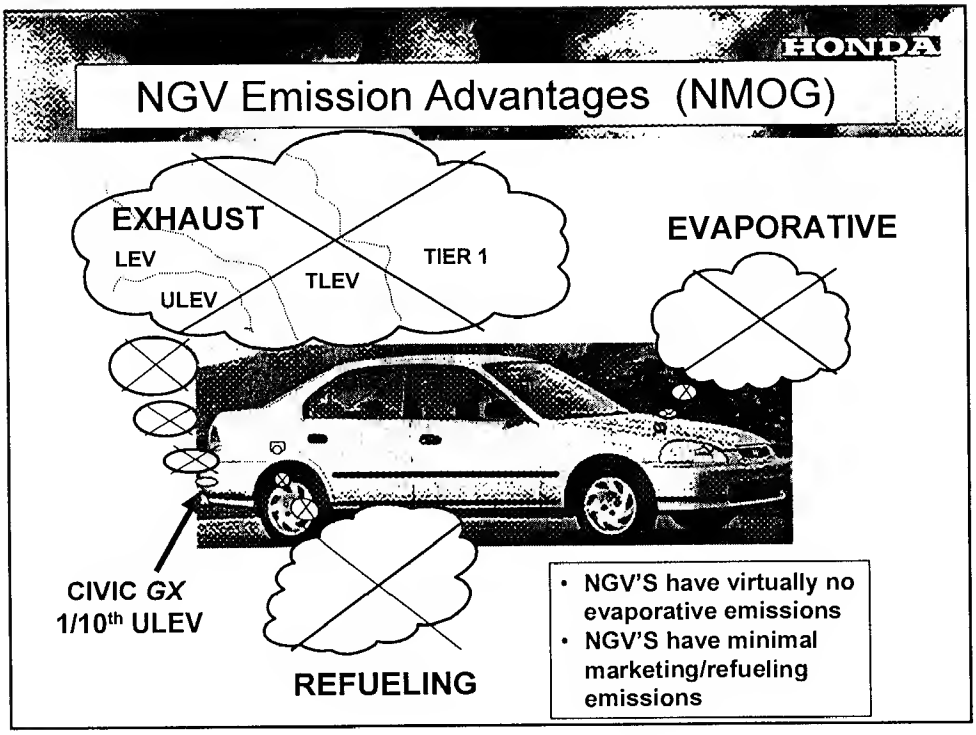
So far, over one million Hondas have been sold with low emission technology, and more than 85% of all our new vehicles are either LEV or better.

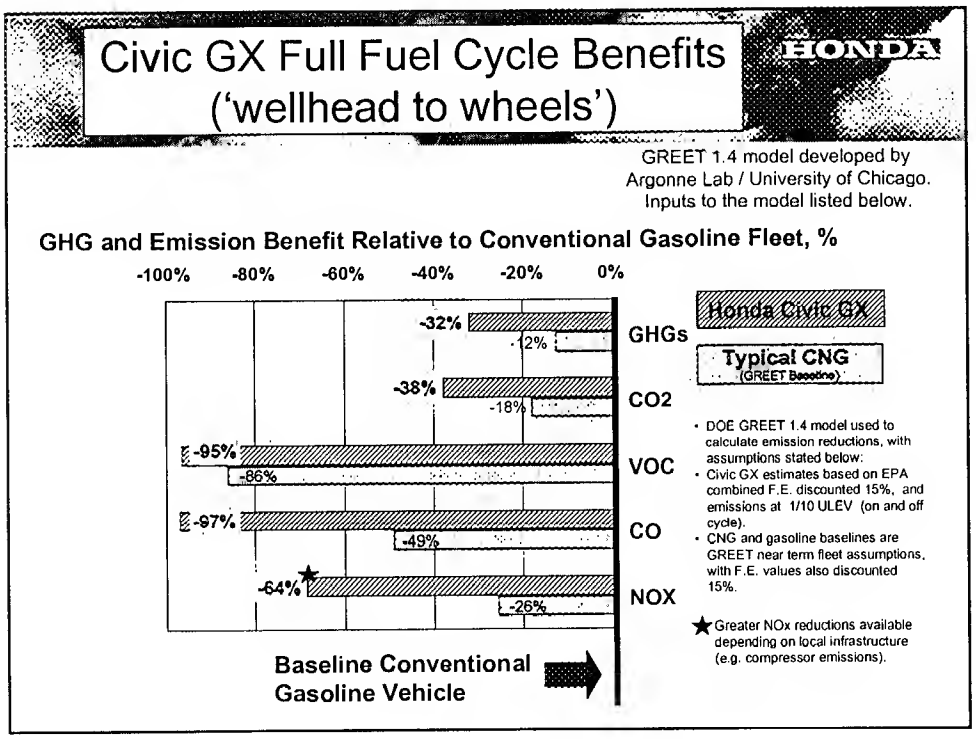
This commitment to clean air really took off in 1975 when our Civic CVCC became the first car without a catalytic converter to comply with emissions standards set by the 1970 U.S. Clean Air Act. We have continued our efforts with great results. For example, in 1995, we voluntarily reduced smog contributing hydrocarbons by 70% and became the first to meet California's strict Low Emission Vehicle (LEV) standard.

Today, the California Air Resources Board has just issued an even stricter emissions standard for 2004: Super Ultra Low Emission Vehicle (SULEV). Naturally, we've decided not to wait. The Accord SULEV will be the first gasoline powered vehicle to meet this standard and is now available in California. Looks like it's time to find a new message for the bumper of your Honda.

HONDA
Thinking.

AIAM-055624


HONDA
NGV Emission Advantages (NMOG)
EXHAUST
LEV
ULEV
TLEV
TIER 1
EVAPORATIVE
CIVIC GX
1/10th ULEV
REFUELING
• NGV'S have virtually no evaporative emissions
• NGV'S have minimal marketing/refueling emissions


Civic GX Full Fuel Cycle Benefits
('wellhead to wheels')
HONDA
GREET 1.4 model developed by
Argonne Lab / University of Chicago.
Inputs to the model listed below.
GHG and Emission Benefit Relative to Conventional Gasoline Fleet, %
-100%
-80%
-60%
-40%
-20%
0%
-32%
-12%
GHGs
-38%
-18%
CO2
-95%
-86%
VOC
-97%
-49%
CO
-64%
-26%
NOX
Honda Civic GX
Typical CNG
(GREET Baseline)
• DOE GREET 1.4 model used to calculate emission reductions, with assumptions stated below:
• Civic GX estimates based on EPA combined F.E. discounted 15%, and emissions at 1/10 ULEV (on and off cycle).
• CNG and gasoline baselines are GREET near term fleet assumptions, with F.E. values also discounted 15%.
★ Greater NOx reductions available depending on local infrastructure (e.g. compressor emissions).
Baseline Conventional
Gasoline Vehicle

HONDA

2000 MY Accord Gasoline SULEV

- SULEV Accord introduced in California February 2000
- Needs California fuel for SULEV levels

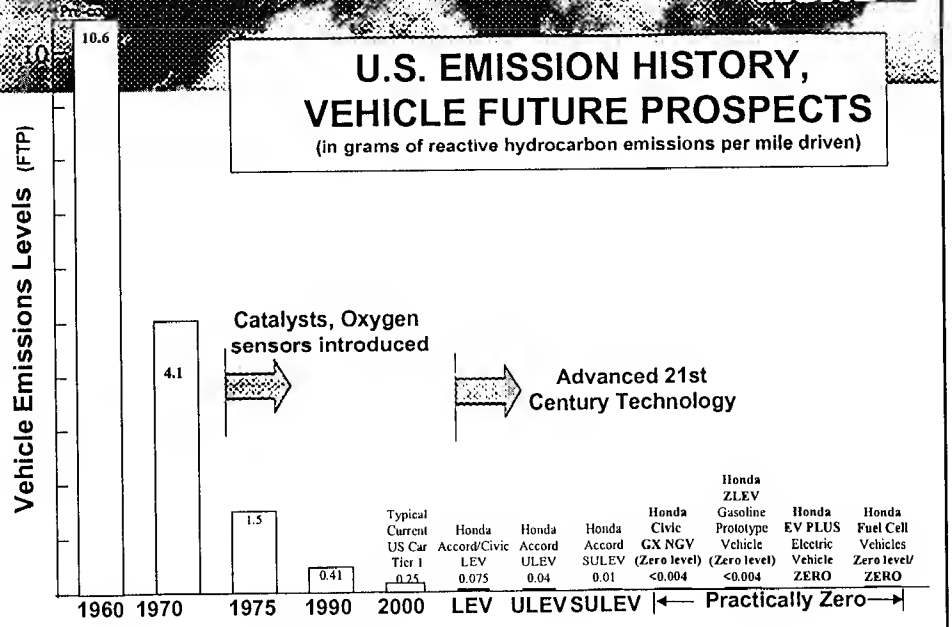
Elements building on ULEV

- Advanced engine start air/fuel control
  - Stable, lean combustion
- Ignition retard during fast idle
  - Faster catalyst lightoff
- "Predictive" air/fuel control
- Advanced catalyst formulation
  - 1200 cell/in^2

HONDA

U.S. EMISSION HISTORY, VEHICLE FUTURE PROSPECTS

(in grams of reactive hydrocarbon emissions per mile driven)



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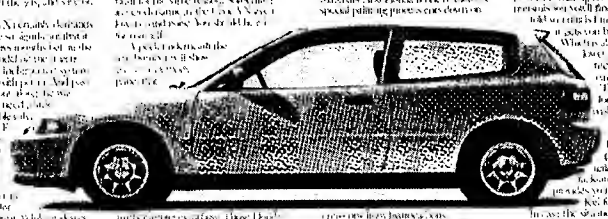
Honda's Fuel Economy Leading Products

Product	Transmission	Model Year	City FE label	Highway FE label
CRX HF	manual	1985	49	54
CRX HF	manual	1988	49	52
Civic HB VX	manual	1992	48	55
Civic HX	manual	1996	39	45
	CVT (auto)	1996	35	39
Insight	manual	2000	61	70

HONDA

1992 to1995 Civic VX ad

Think of what you can save.



The New Civic VX

HONDA

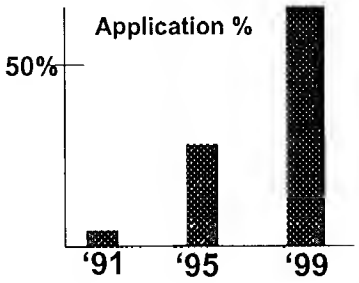
FUEL EFFICIENCY IN MASS MARKET PRODUCTS

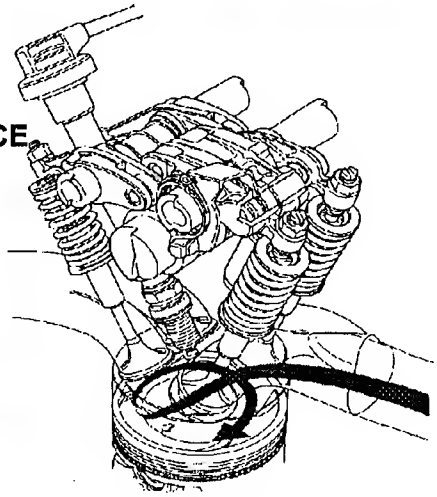
- Efficient power train technology applications
- Incremental weight reduction advancements
- Advanced incremental technology applications (CVT, lean-burn, VTEC, etc.)

HONDA

HONDA VTEC

- HIGHER EFFICIENCY
- LOWER EMISSIONS
- GREATER PERFORMANCE





Average Smog-Forming and Global Warming Emissions

HONDA

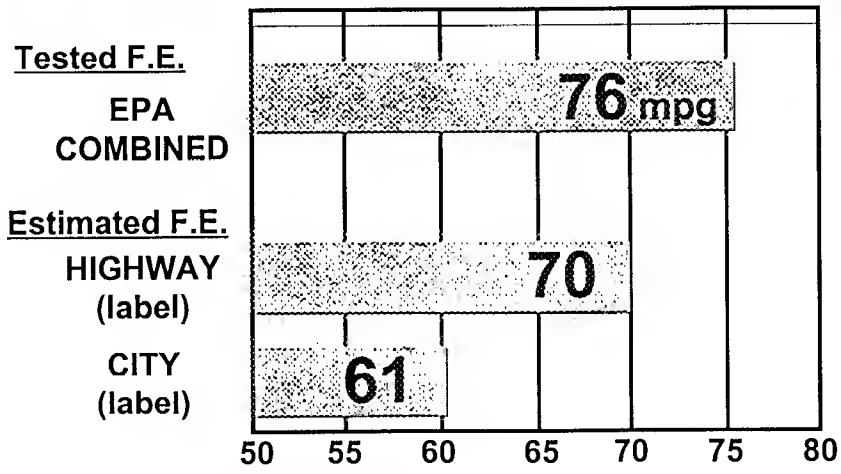
Automaker (Best → Worst)	Smog-Forming Emissions (NO_x+ HC g/mi) Overall	Cars	Trucks	CO_2 Emissions (CO_2-equivalent gases) Overall	Cars	Trucks
Isuzu	0.99	n/a[d]	0.99	599	n/a	599
DaimlerChrysler	0.86	0.61	0.99	570	453	624
Ford	0.82	0.61	1.00	558	465	637
General Motors	0.78	0.63	0.99	521	460	607
BMW	0.62	0.62	n/a	504	504	n/a
Mitsubishi	0.70	0.42	0.95	456	431	569
Nissan	0.66	0.60	0.79	473	422	577
Toyota	0.65	0.55	0.83	464	420	545
Volkswagen	0.66	0.66	n/a	446	446	n/a
Subaru	0.59	0.59	n/a	464	464	n/a
Honda (Best)	0.45	0.43	0.61	409	402	473

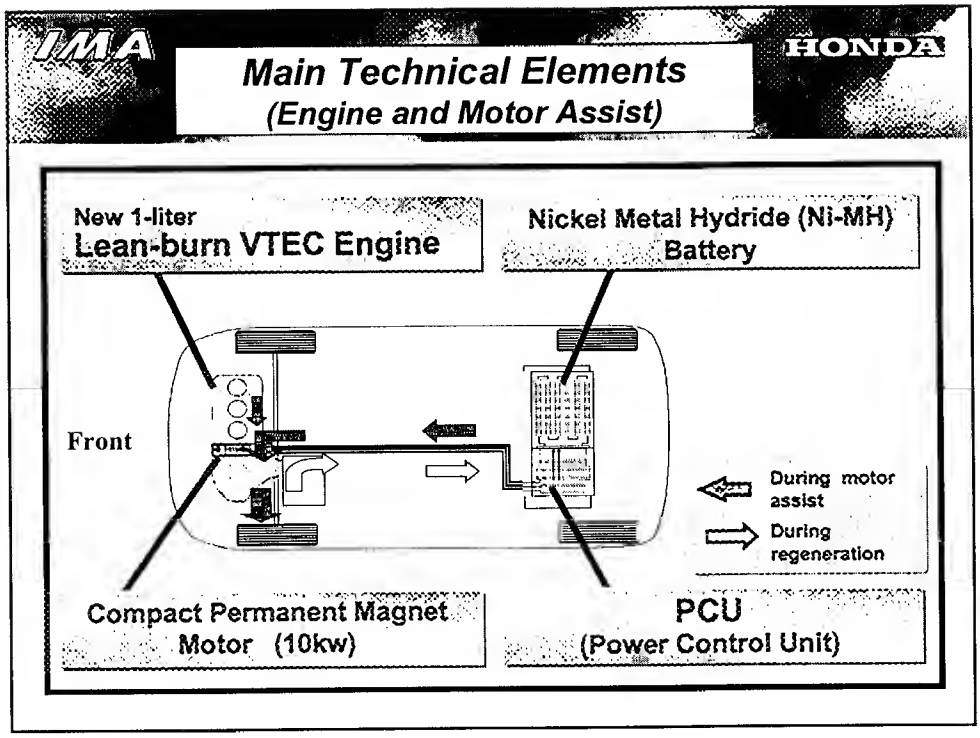
SOURCE: Pollution Lineup, UCS, for 1998 MY

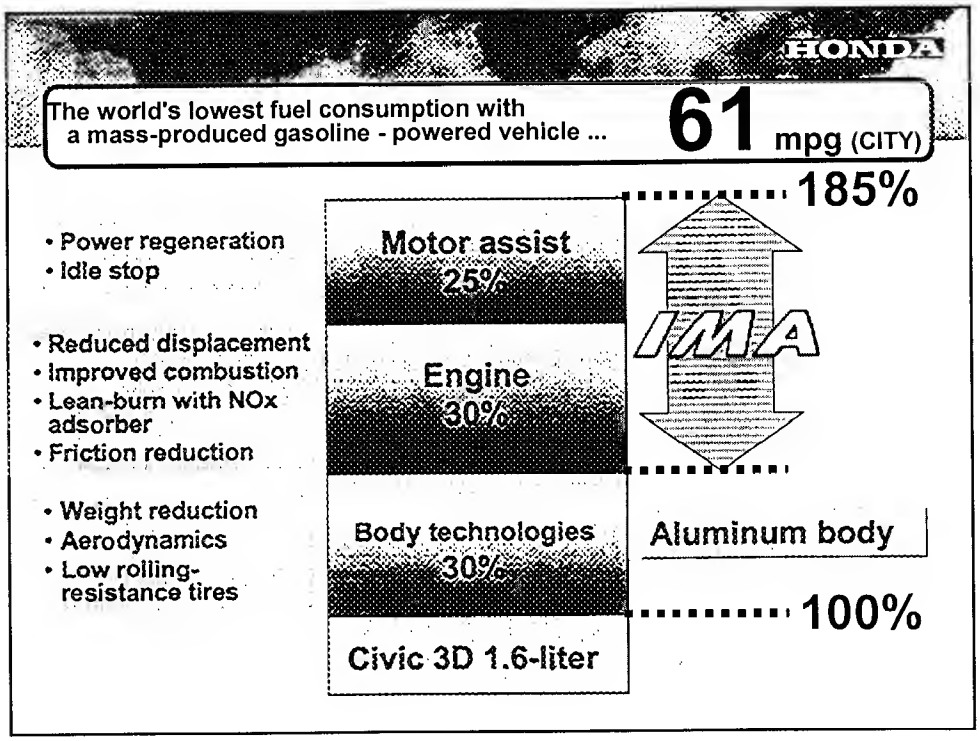
Insight

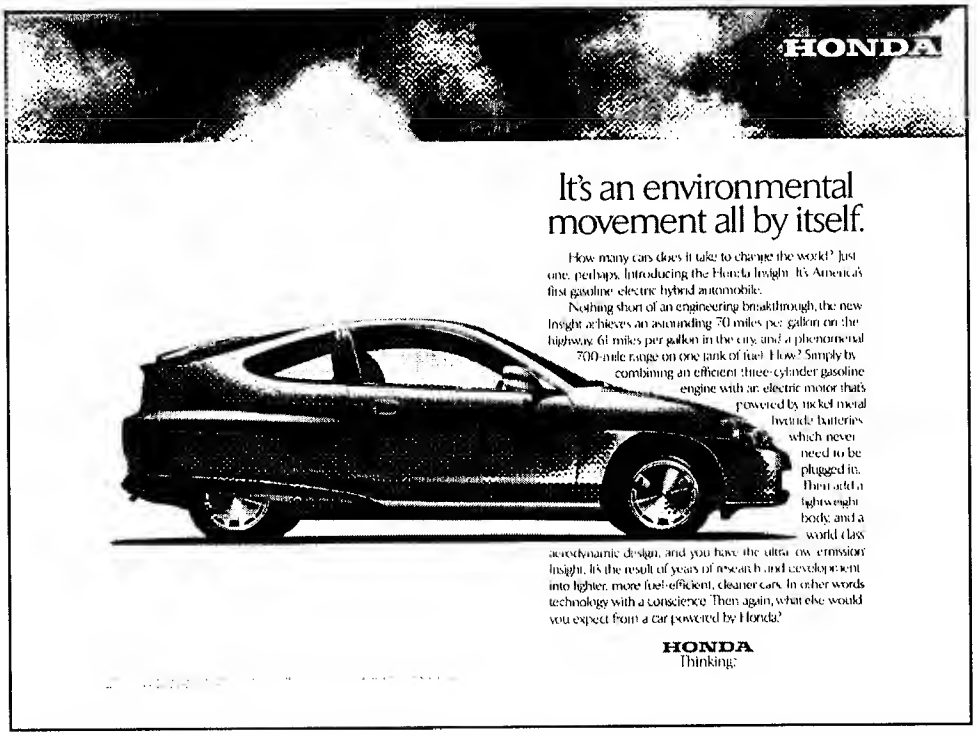
HONDA

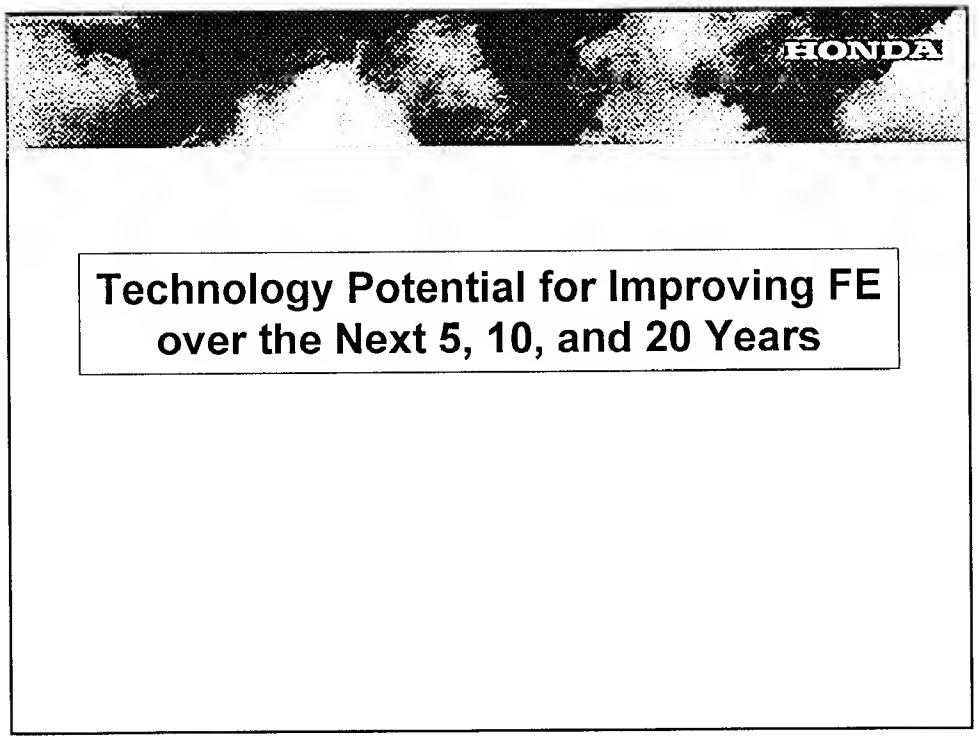
Fuel Efficiency




IMA
HONDA
Main Technical Elements
(Engine and Motor Assist)
New 1-liter
Lean-burn VTEC Engine
Nickel Metal Hydride (Ni-MH)
Battery
Front
During motor assist
During regeneration
Compact Permanent Magnet
Motor (10kw)
PCU
(Power Control Unit)


HONDA
The world's lowest fuel consumption with
a mass-produced gasoline - powered vehicle ...
61 mpg (CITY)
185%
• Power regeneration
• Idle stop
Motor assist
25%
• Reduced displacement
• Improved combustion
• Lean-burn with NOx adsorber
• Friction reduction
Engine
30%
IMA
• Weight reduction
• Aerodynamics
• Low rolling-resistance tires
Body technologies
30%
Aluminum body
100%
Civic 3D 1.6-liter


HONDA
It's an environmental movement all by itself.
How many cars does it take to change the world? Just one, perhaps. Introducing the Honda Insight. It's America's first gasoline-electric hybrid automobile.
Nothing short of an engineering breakthrough, the new Insight achieves an astounding 70 miles per gallon on the highway, 61 miles per gallon in the city and a phenomenal 700-mile range on one tank of fuel. How? Simply by combining an efficient three-cylinder gasoline engine with an electric motor that's powered by nickel metal hydride batteries which never need to be plugged in. Then add a lightweight body and a world-class aerodynamic design, and you have the ultra-low emission Insight. It's the result of years of research and development into lighter, more fuel-efficient, cleaner cars. In other words technology with a conscience. Then again, what else would you expect from a car powered by Honda?
HONDA
Thinking.


HONDA
Technology Potential for Improving FE over the Next 5, 10, and 20 Years

AIAM-055631

HONDA

Future Powerplant Issues

Technological solutions

Fuel Cell/CNG/Hybrid
Methanol/Ethanol/H2/Li-ion....

Hybrid/Materials/Structure/Lean-Burn/DI/ Diesel/Energy storage/New AT/Tires/CNG
[CAFE ?/$ Incentive]

Friction reduction/VTEC/ Aerodynamics/ Improved transmissions/Low resistance tires
[Incremental Improvements]

HONDA

Incremental Improvement Technologies

- Engine technology
  - High specific output (including 4 valve/cylinder)
  - VTEC & VTECi
  - Direct injection
  - Precise air/fuel metering
- Transmission efficiency
  - 5 speed-AT/6-speed MT
  - CVT
- Reduced losses
  - Lightweight materials
  - Low drag coefficient
  - Low resistance tires
  - Lower accessory losses

Cost and value issue

These technologies are continuously being incorporated in the products.

However, consumers sense of value usually puts fuel efficiency near the bottom of their list.

Putting in these technologies just to improve fuel economy may not be valued by customers.

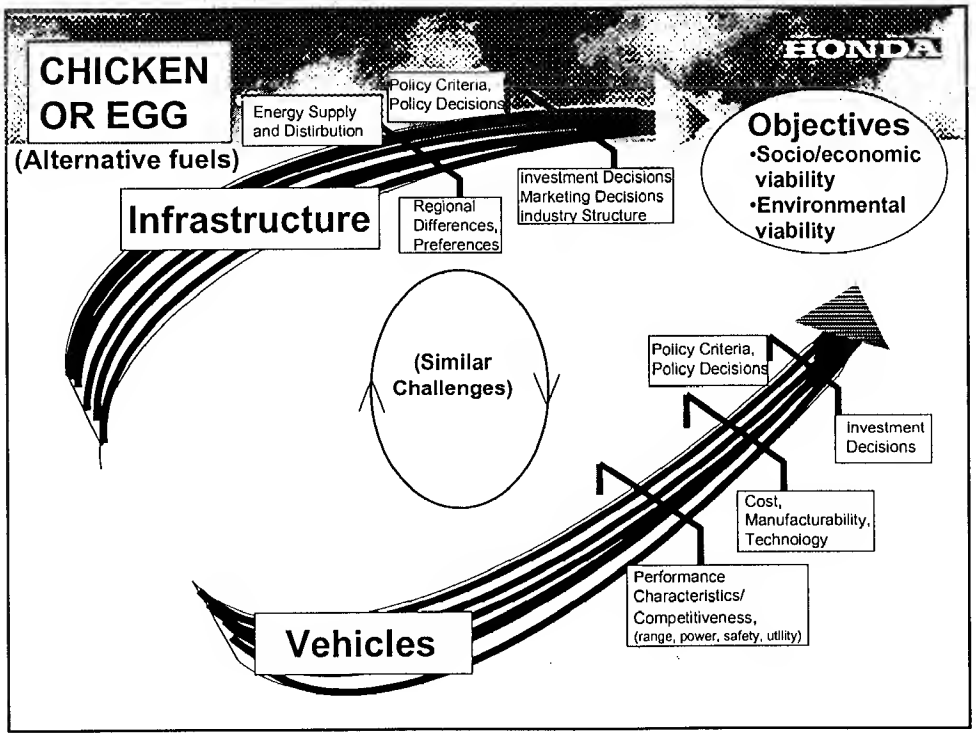
Fuel Economy Improvement - ???

Depends on how much is already incorporated into fleet and synergies (or lack of synergy) between technologies

New Technology Limitations

- Lean-burn: NOx catalytic reduction, fuel sulfur, cost
- Cylinder cut-off: Cost, vibration
- Idle-off: Cost, packaging
- Hybrids: Cost, packaging
- CNG (20% less CO2): **Infrastructure**, cost
- EV: Cost, recharge time, **range** (still in research stage)
- PNGV technologies
- Fuel cell

} **Future research items**

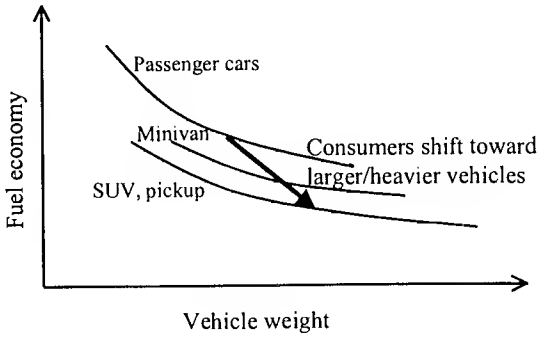


HONDA

Socio-Economic Issues in US

Customers do not recognize any individual needs/responsibility to help reduce GHG emissions

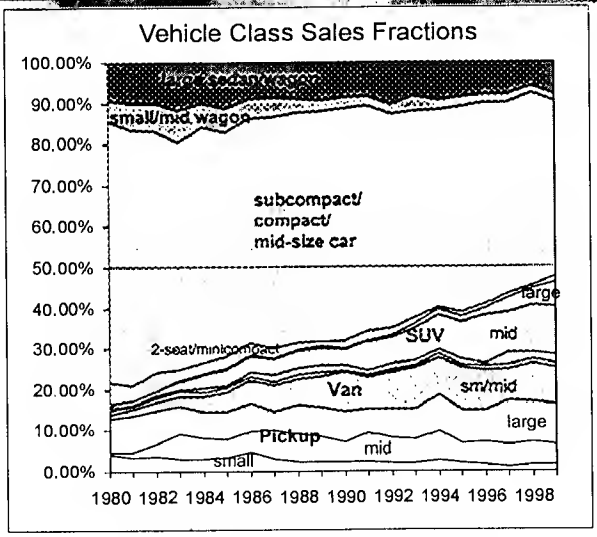
- Gasoline is cheap
- New vehicle demographics very upscale
- Little public understanding that fuel consumption correlates with GHG emissions



HONDA

Light Truck Sales Will Continue to Expand

- # of SUV models expected to double in four years
- GM has predicted "sport wagons" (car/truck hybrids) will reach 1-1.5 million sales/year
- LEV-II/Tier 2 won't affect sales
- As long as gasoline remains cheap, customers will value other features higher than fuel economy:
  - Safety
  - Utility
  - Performance



1999 Light-Duty (<8500 GVW) Fuel Economy Trends Report

HONDA

Fuel Cells: The Holy Grail

Advantages:

- Very high fuel conversion efficiencies
  - Greatly reduced heat loss
- Virtually zero emissions
- Quiet
- Reliable and long lifetime
- Low maintainanace
- Wide range of applications in addition to vehicles

Challenges

- Packaging, size, weight
- Cost
- Waste heat rejection
  - Low temperatures ⇒ inefficent radiators
- Air supply ⇒ Compressor
- **Hydrogen supply**

HONDA

Hydrogen Fuel Issues

On Board Storage

- Compressed gas → Very low energy density
- Liquid hydrogen → Very low temperature; Parasitic losses
- Metal hydride → Low energy density; Conversion issues

Hydrogen infrastructure

On Board Reformer

- Reduced efficiency
- Hydrogen dillution
  - larger fuel cell
- Start-up performance
- Transitional response
- CO and sulfur control
- Emissions from reformer
- Size, weight, packaging
- Cost

Methanol reduces problems and has sufficient range, but adds **infrastructure issues**

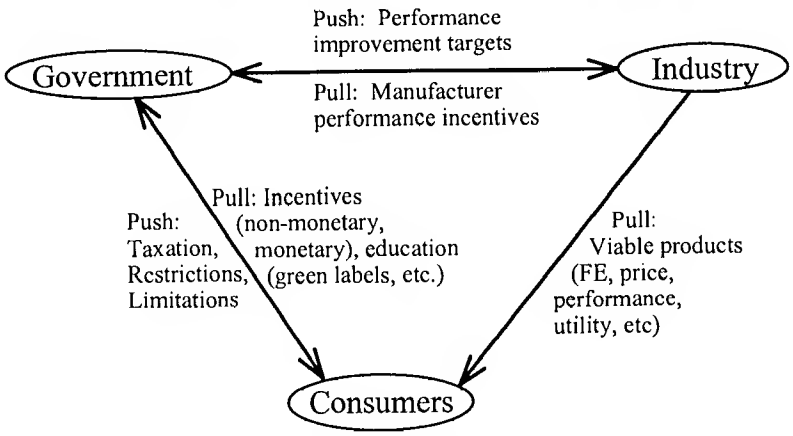
HONDA

Honda's Position on GHG Issues

- Honda is committed to contributing to mitigation of GHG emissions through technology progress.
- Honda believes it is our responsibility to develop and offer efficient products in the market. We have been doing this and will continue to do so.
- However, the customer needs to become an integral participant in the process of reducing greenhouse gases; market acceptance of these products will be limited until this occurs.

HONDA

Cooperation is Essential



Note: Push/Pull descriptions are examples of items that could be included in a cooperative program. This should not be interpreted as Honda support for specific items, especially individually.

The Road to Clean Cars:
Technological Promise and Policy Challenge

John M. DeCicco

Energy and Environmental Studies Institute
Congressional Briefing on Advanced Vehicle Technology
May 18, 2000

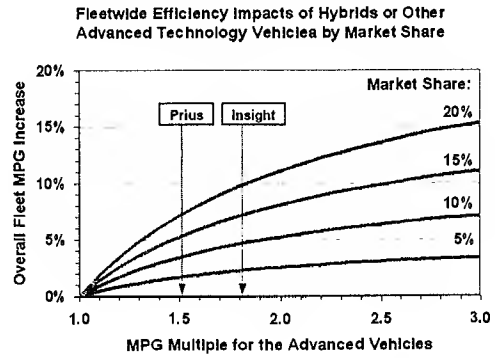
American Council for an Energy-Efficient Economy
1001 Connecticut Ave NW, Suite 801 • Washington, DC 20036
202-429-8873 • fax 202-835-2620 • e-mail DeCicco@aceee.org

AIAM-055638

AIAM-055639

Market Realities

- Proven & Profitable market interest runs counter to higher efficiency and other environmental needs.
- New fleet fuel economy has been stagnant or declining
  - » U.S. fleet average efficiency has been declining since 1988.
  - » European fuel efficiency trends are essentially flat, even at much higher fuel prices.
- Larger, more powerful vehicles are popular everywhere.
- Even the most optimistic "advanced technology vehicle" introduction plans are unlikely to offset the growth in GHG emissions due to mainstream market trends.



Prognosis for Automotive Fuel Cells

- PEM fuel cell is likely to eventually have low cost.
- It may be best joint solution addressing air quality, GHG, oil dependence, and future customer needs.
- Several development and cost paths must converge:
  - Integrated fuel cell engines and ancillary devices
  - Maturation of electric drivetrain technologies
  - Fuel choice and infrastructure (now quite unclear)
- True mass market seems unlikely before ≈ 2015, so fuel cell vehicles cannot significantly address climate action needs until later dates.

Components Common to All Vehicles using Electric Drive

- Traction motors, controllers, other power electronics.
- Batteries for regenerative braking, perhaps peaking.
- Electrodrive system (motor+controller) costs:
  - Presently on order of $200 per kW (retail equivalent)
  - In the long run, can fall to $20–$30 per kW (2000$)
- Attaining such low costs will be essential for wide-spread deployment of any electric drive vehicle.

Societal Concerns that Influence Vehicle Design

- **Safety**
- **Environment**
- **Energy**

SAFETY

Regulation

- Federal safety standards since 1966
- Focus: restraints, crashworthiness, crash avoidance
- Limitations: rollover, aggressivity

Consumer Interest

- Historically was very limited
- Stronger concern in recent years
- Some technologies deployed without regulation (e.g., ABS)

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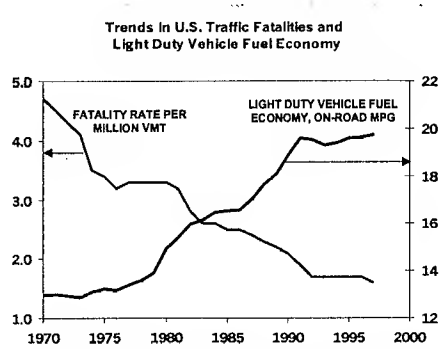


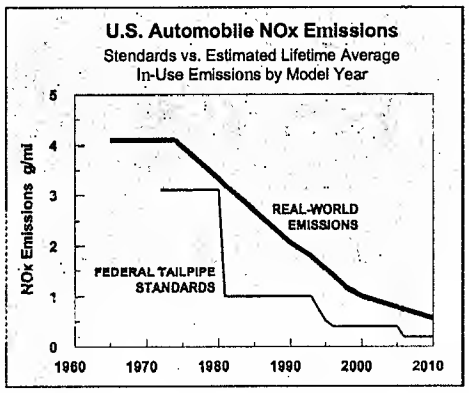
ENVIRONMENT
(Criteria Air Pollution)

Regulation

- California & Federal standards since 1960s
- Focus: reduce tailpipe emissions on lab tests
- Limitations: in-use performance of engines; lax diesel standards; ZEV mandate faces cost and technology hurdles.

Consumer Interest

- Traditionally very weak
- Potentially emerging appeal, with LEVs, HEVs, corporate image ads
- No signficant technology deployment (in terms of net pollution reductions) without regulation, until recent national LEVs



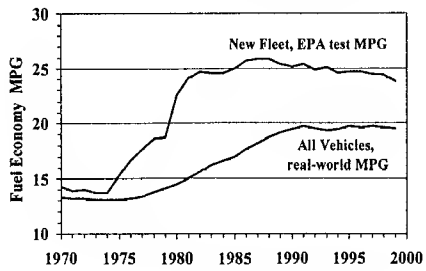
Energy

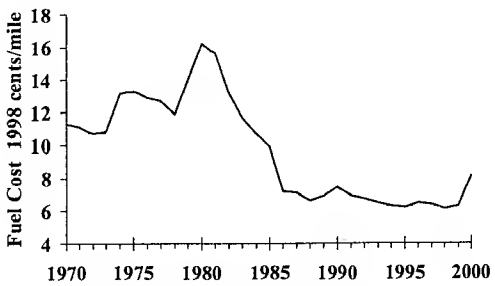
Regulation

- CAFE standards in 1975
- AFV credits set in 1988; fleet requirements in 1992
- Focus: economics and energy security
- Limitations: weak legal links to environment, in spite of strong impact; lax light truck standards

Consumer Interest

- Intense during oil shocks
- Weak since mid-1980s and growing weaker
- No market-driven fuel economy increases except during energy crisis
- Environmental link is intuitively understood, but not well communicated





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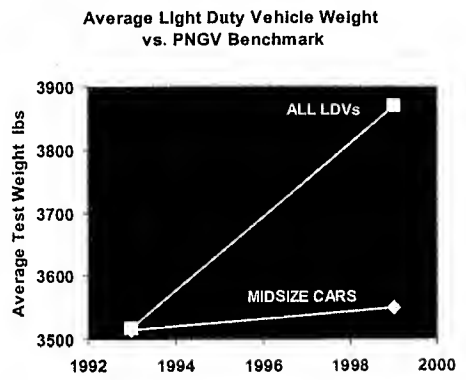
Gasoline Taxes in Perspective

There may be good reasons to raise gasoline taxes:

- funding intermodal system improvements
- more equitable transportation cost allocation
- incentives pool for low-carbon fuels

but motivating car and light truck fuel economy and technology improvements isn't one of them.

It is more likely that fuel taxes or other road user fees will need to be raised to maintain transportation funds in the face of rising vehicle efficiency than it is that higher fuel taxes induce higher fuel efficiency.

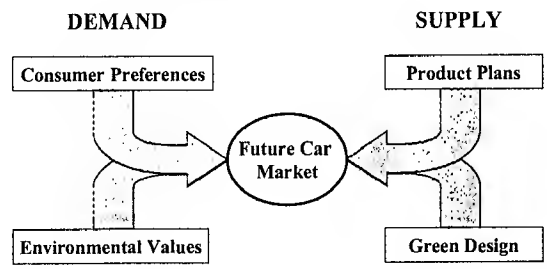


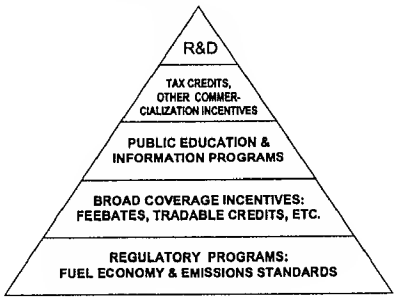
PNGV
One Step Forward, but Several Steps Back

- Landmark articulation of shared objectives
- Chronic neglect of Goal 2
- Credibility undermined by use of PNGV to lobby against other environmental policies.
- Continuing industry subsidization without accountability is questionable.
- Bottom line: since PNGV started in 1993,
  new fleet fuel economy is down 5%
  overall auto CO_2 emissions are up 18%.

It's Not (just) Technology, It's the Market (stupid!)

Greening the Market Means Closing the Gaps





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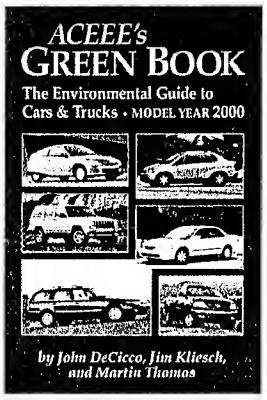

ACEEE's Automotive Consumer Information Strategy

- Stand-alone consumer guide
- Resource for automotive media and educators
- Stimulate expanded government information and labeling initiatives
- Encourage others to use Green Scores

ACEEE's Green Book™ is available online at `www.GreenerCars.com`

Suggestions for Congress

- Restore funding for CAFE rulemakings.
- Enact tax credits for clean, high-efficiency advanced technology vehicles.
- Appropriate (authorize as needed) expanded resources for public information, labeling, and market creation initiatives.

Suggestions for Administration

- Veto the Transportation Appropriations bill if it includes a rider inhibiting CAFE rulemaking.
- Strengthen informational and marketing efforts with a "Green Vehicle Marketing Partnership."
- Develop agency capacity (EPA, NHTSA) for comprehensive approaches for addressing auto fuel efficiency/CO_2 and safety issues.
- Reform research programs to strengthen deployment efforts and set forward-looking goals for criteria emissions.

Suggestions for Public Interest Groups

- Pursue efficiency, safety, and emissions standards for addressing the entire car and light truck fleet, avoiding over-emphasis of alternative vehicles.
- Embrace challenges of bringing customer demand in line with environmental values (it's not just "if you build it, they will buy").
- Pursue market incentives to discourage inefficient vehicles and encourage greener vehicles.

Suggestions for Automakers

- Acknowledge the essential role of regulation in enabling responsible corporate citizenship.
- Stop opposing CAFE standards and begin good-faith negotiations on fuel economy improvement.
- Collaborate in developing incentive structures and marketing approaches that can better align product plans and customer value with sustainability goals.

Conclusions • Realizing the Benefits of Next-Generation Vehicle Technology

- R&D and market forces modified only by incentives will not suffice.
- Stagnation of CAFE standards has vehicle design running counter to sustainability.
- Renewed regulatory guidance is essential.
- Market-oriented programs can complement regulation to build a complete strategy.

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